SUBSTITUTE SPECIFICATION

TITLE OF THE INVENTION

SAFETY SWITCH WITH AN ELECTRONIC PROGRAMMABLE SYSTEM

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001] The present invention refers to a safety switch with an electronic programmable system.

[0002] More particularly, the present invention refers to a safety switch with an electronic programmable system being particularly but not exclusively useful anytime that the need to be sure that an element reaches a certain position with respect to another one arises, such as for the bolts of lift doors.

2. DESCRIPTION OF THE RELATED ART

[0003] It is known that in various applications it is necessary to be sure that an element reaches a predefined position with respect to another one before the subsequent event takes place. One of these applications is the control of the bolts of lift doors wherein their opening and/or closing must take place safely according to the provisions ruling the security classes.

[0004] In order to meet these safety requirements, mechanical devices provided with electric or electromechanical sensors interacting with the opening devices of the doors are generally known and used. In particular, for safety reasons, the bolt of the lift doors is associated with the lift cabin operator and it is mechanically operated.

[0005] Even though these devices achieve the purpose, they are not free from drawbacks such as the manufacturing complexity due to the interaction needed between the electrical and the mechanical devices, the installation difficulty due to the restricted spaces available, the physical calibration needed of the various component in order to assure the correct interaction among the above-mentioned devices.

BRIEF SUMMARY OF THE INVENTION

[0006] An object of the present invention is to provide a safety switch with an electronic programmable system being able to remove the above-mentioned drawbacks with reference to the prior art.

[0007] A further object of the present invention is to provide a safety switch with an electronic programmable system that is easily manufactured and installed in restricted spaces and does not need physical calibration.

[0008] According to the present invention, these and other purposes resulting from the following description will be attained by a safety switch with an electronic programmable system.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0009] The building and functional features of the safety switch with an electronic programmable system of the present invention will be better understood from the following description, wherein reference is made to the Figures of the attached drawings representing an embodiment of the device which is given only by way of illustrative and non-limitative example wherein:

[0010] Figure 1 is a schematic view of a door bolt provided with the safety switch with the electronic programmable system of the present invention;

[0011] Figure 2 is a check diagram of the relay status; and

[0012] Figures 3 to 11 represent the managing software flow chart of the safety switch with the electronic programmable system of Figure 1.

DETAILED DESCRIPTION OF THE INVENTION

[0013] With reference to Figure 1, a door bolt provided with a safety switch with an electronic programmable system 2 of the present invention is marked in its whole by 1.

[0014] The door bolt 1, which is known in itself and therefore it is not described in detail, comprises a support element 3, and a tilting element 4 provided with stopping means, that are rotatingly associated with the support element 3 and to a matching element 6 provided with stopping opposite means 7.

[0015] Moreover, the tilting element 4 is provided with a support element 8.

[0016] The safety switch with the electronic programmable system 2 comprises a group of two single-contact relays 9 connected in series, associated with the matching element 6 and a proximity element 10 associated with the support element 8 of the tilting element 4.

[0017] The relay group 9 is provided with magnetic sensors to check the contact status of each of the two relays of two calculation units. These magnetic sensors are sensitive to the orientation of the flow lines of the surrounding magnetic field.

[0018] The proximity element 10 is provided with a magnet 11 that is able to generate a magnetic field variation that can be detected by the magnetic sensors. The magnetic field variation is a function of the distance of the magnet 11, associated with the tilting element 4, from the magnetic sensors 11 associated with the group of the two relays 9.

[0019] The control of the relay status defining the position of the bolt and therefore the safety of the switch is carried out as shown in Figure 2 using only the NA contact. It can be noticed that, in this scheme, the only contact 12 and 13 of the single relays, the power connectors 14, the connectors of the control signals 15 and 16 and the connector 17 common to the two relays are shown. Two transformers 18 and 19 assure the insulation of the safety circuit.

[0020] The connectors of the control signals 15 and 16 are connected to one end with one output of one relative calculation unit of the two calculation units and to the other end with the magnetic sensors of a relative relay. The common connector 17 is connected to one end with the magnetic sensors of the two relays and to the other one with an entry of the two calculation units.

[0021] The control is managed by the two calculation units of the safety switch and takes place by sending a fixed number of pulse width modulation (pwm) fixed-frequency pulses to each of the magnetic sensors of the single-contact relays 12 and 13 through the connectors 15 and 16 and controlling the return of the same pulses through the connector 17. As these pulses are in common with the return connector 17, they are alternatively sent to the magnetic sensors of the two single-contact relays 12 and 13; in other words, first to one magnetic sensor and then to the other. The pwm pulses have

preferably a frequency of 50KHz divided into packets of 1 second for a total of 50 pulses for each audit window. Between the sending of the pulses to the magnetic sensor of the first single-contact relay and the sending to the magnetic sensor of the second single-contact relay, a delay time of the line engaged is advantageously left. Moreover, the time of the control cycle is advantageously divided at 50% on the two single-contact relays.

[0022] The two calculation units can determine the status of the contacts of the single relays from the return of the pulses; in other words if the pulses sent to the magnetic sensor of both the single contact relays 12 and 13 return, both the single-contact relays are closed; or if they do not return they are open. In this way, the two calculation units can give the permission to the movement of the cabin, in case of a lift; or deny it enabling an alarm signal.

[0023] In Figure 3 the flow chart of the initialization cycle and of the main cycle of the management software of the safety switch with the electronic programmable system 2 is shown.

[0024] The initialization cycle is represented in detail in Figure 4 and it mainly comprises the initialization and control configuration steps, the error check and the execution and, during testing, the calibration procedure.

[0025] Figure 5 shows the alarm cycle that is forced in case of errors during the initialization step.

[0026] Figure 6 shows the flow chart of the calibration procedure comprising the acquisition steps of all the reference and control values.

[0027] Figures 7 to 11 show in detail the management steps of the switch and, in particular, Figure 9 shows a flow chart of the control of the single-contact relays.

[0028] Advantageously, the safety switch with the electronic programmable system of the present invention does not need physical calibrations as all the management and control parameters are defined and acquired by an appropriate program block executed at the first start.

[0029] The safety switch with the electronic programmable system of the present invention can be advantageously used each time that an element must be in a certain position before the permission to the subsequent action is given such as in machine tools wherein protections must be safely closed before starting the working cycle.

[0030] As it can be noticed form the previous description, the safety switch with the electronic programmable system of the present invention is functional and versatile; moreover it can be easily manufactured at low costs thus allowing the attainment of its purpose and overcome the above-mentioned drawbacks with reference to the prior art.

[0031] Even though the present invention has been described above with reference to an illustrative embodiment, which is given only by way of non-limitative example, it is clear that technicians skilled in the art can make various changes and variants according to the above-mentioned description. It is therefore understood that the present invention is meant to include all the changes and variants falling within the spirit and the protective scope of the following claims.